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7000 Hazardous Materials Response (HAZMAT)

7100 Background

Response actions for hazardous materials spills are more diverse than those for oil spills. Hazardous materials incidents rely more heavily on the use of augmenting forces from state and local governments, and place much greater emphasis on monitoring and data gathering prior to any commitment of resources. Key differences between oil and hazardous material spill responses are shown in Figure 7-1. All personnel should understand these differences when participating in Unified Command systems that must manage a response. Section 7400 provides technical guidance for the required risk analysis. *Section 9450* has three hazardous materials planning scenarios.

USCG Activities Baltimore maintains a conservative posture with regards to hazardous material releases, they are not trained for hazardous material site entry. The Maryland Department of the Environment maintains a much more aggressive posture and regularly enter hazardous material site. Likewise, local fire departments are also much more aggressive towards hazardous material incidents and train for such scenarios. The FOSC will provide technical assistance and perform control functions during a hazardous material releases, but cannot enter the zone of contamination or “hot zone”. This is defined as the zone in which workers must wear any of the special equipment shown in Figure 7-2 to protect against inhalation or dermal contact hazards. Such workers must be trained and medically certified in accordance with the OSHA regulations in 29 CFR 1910.120.

Figure 7-1 Differences in Oil and Hazardous Material Spill Response

Issues	**Oil**	**Hazardous Materials**
Substances	• Few (gasoline, diesel, crude) • Limited vapor hazards, some dermal hazards. • Visible. • Large spill volumes.	• Many (>300 moved in large quantities) • High vapor and/or contact hazards. • Often invisible. • Smaller spill volumes.
Risk Perceptions	• Low risk. • Understood by public. • Relatively safe to responders. • Mainly natural resource damage.	• High risk. • Complex situation. • More dangerous to responders. • Public feels directly threatened.
Predictable Models	• Fate and short term effects understood.	• Many outcomes which vary with substance.
Public Expectations	• Anybody can cleanup. • Many experts.	• Experts must cleanup. • Few experts.
Goals	• Protect natural resources. • Protect economy. • Protect public health.	• Prevent escalation, • Prevent death/injury to responders. • Protect public health.
Resulting Tactics	• Large organization.	• Small organization. • Specialized HAZMAT

Resulting Tactics Continued	• Pre-staged assets. Surge mobilization • Contain and recover spilled oil.	teams. • Secure “hot zone”. • Evacuate the public or shelter in place to minimize exposure. • Secure the source. • May have to bring vessel to safe haven. • May be impossible to recover chemical. • Conduct remote monitoring.

After G.Ott, “Teflon Boom and Stainless Steel Skimmers, A Doctrine Approach to Fill the Chemical/Oil Planning Gap”.

Figure 7-2 OSHA Personal Protective Equipment Levels for HAZMAT Workers

OSHA Level	**Protective equipment**	**Conditions of use**
D	Varies from normal work uniform to limited splash protection.	• Must be outside vapor hazard zone. • Limited dermal contact hazards.
C	Splash protection and air purifying respirator (“gas mask”).	• Low to moderate vapor hazard, sufficient O_2. • Used only in well characterized atmospheres. • Must be able to smell breakthrough in respirator cartridge before concentration becomes dangerous.
B	Self-contained breathing apparatus (SCBA), splash protection, and chemical resistant	• High/unknown vapor hazard. • Often used for initial reconnaissance. • Not for toxic or corrosive

	boots	vapors which can be absorbed through the skin.
A	SCBA, fully encapsulating chemical resistant suit ("moon suit"), and chemical resistant boots	• High/unknown vapor hazards, including skin absorbers and corrosives • Generally provides no protection against fire or explosion. Some available with flash protection. • Design of suit limits peripheral vision, mobility. • Work time in hot zone limited by air supply. Typically 20-35 minutes, depending on body weight and physical fitness.

Within the Baltimore AOR, state and some local governments maintain HAZMAT response teams that have entry capability and can carry out a response to a hazardous materials release. When the state and local government teams can adequately respond to a release, the FOSC will not interfere.

No matter who carries out the actual response, the FOSC must monitor for adequacy. If the response is not adequate, the FOSC shall provide advice to the responders and/or assume control of the response. See Section 7300 and Section 7400 below for a description of steps to be taken by the FOSC.

The HAZMAT teams that are maintained by state and local governments normally function only on land. If the maritime aspects of the situation become dominant and prevent land-based HAZMAT teams from adequately responding (and the ship cannot be moved to a safe haven), assistance may be sought from the Coast Guard's National Strike Force/Atlantic Strike Team. This team is trained to respond to shipboard hazardous materials incidents and can enter the "hot zone" if necessary. The Atlantic Strike Team can also help land-based HAZMAT teams to adjust their tactics to the maritime environment.

A hazardous materials incident has a zone of contamination; generally termed a “hot zone”, in which chemical vapors, dermal contact hazards, fires, explosion hazards, or nuclear radiation pose a threat to unprotected workers. Leading from the “hot zone” to the “cold” (non-contaminated) zone is a “warm zone” in which workers are decontaminated. Traffic controls may or may not be in place at the site, depending on the maturity of the incident and the available personnel.

Some chemicals can be sensed by odor long before they become harmful, others cannot. Published information on odor thresholds is hard to find. Refer to guide books on the relationship between the odor threshold, the breathing limits for workers, and the IDLH (Immediately Dangerous to Life and Health) concentration. Ten percent of the IDLH value is often used as a “hot zone” boundary.

7200 Initial Emergency Response Procedures

1. First contacts are to obtain as much information as possible so that a decision can be made regarding response. Identify/notify the lead agency, usually the local fire department or the Maryland Department of the Environment and determine if they require assistance.

2. When completing the response check-off for hazardous materials releases, pay particular care in recording the exact name of the hazardous substance involved. There are literally thousands of chemicals in commerce in the United States, and many have similar names. Ask for a spelling, or for the United Nations identification number. This is a four-digit number prefixed by “UN”, normally shown inside an orange rectangle on the container. If the chemical cannot be specifically identified, ask for the color and general description of any visible HAZMAT placards.

3. Possible sources of information for completing initial notification check off sheets are:
   - The reporting party,
   - Carrier,
   - Shipper,
   - Manufacturer,
   - Local authorities on scene,
   - Shipping papers, and
   - CHEMTREC (1-800-424-9300).
   - For vessel incidents, the USCG Activities Baltimore Arrival Log may provide information.

4. If the chemical poses an inhalation hazard, the magnitude of the threat will be determined by: the amount spilled, the wind speed and direction, and the air and water temperatures. First contacts should assemble as much of this information as possible. The wave height may also become an important variable. Since the Chesapeake Bay is so shallow and indented, the wave height is not often correlated with wind speed in the manner observed in the open sea, and should be recorded from actual observations.

5. Five official publications provide vital information for hazardous materials spill response, but many others may also be available to assist in the response:

- Department of Transportation, *2000 North American Emergency Response Guidebook.* This pocket guide provides information on chemical identification, general hazard, isolation distances, and evacuation zones. The index pages are used to identify chemicals from their UN numbers. It replaces the 1993 Emergency Response Guidebook. All HAZMAT response teams in the United States, Canada, and Mexico carry it. The evacuation zone table provides worst-case data for spills up to the size of an intermodal tank container.
- *U.S. Coast Guard, Chemical Hazards Response Information System (CHRIS).* COMDTINST M16465.12, a comprehensive loose-leaf guide to the properties of several thousand hazardous chemicals. This is available in the Activities Baltimore library.
- *National Institute for Occupational Safety and Health, Pocket Guide to Chemical Hazards*. Gives exposure limits, health effects, and protective equipment requirements for hazardous chemicals. This book is directed toward personnel with formal training in industrial hygiene, and a highly abbreviated format is used.
- U.S. Coast Guard, *Chemical Data Guide for Bulk Shipment by Water*, a more compact volume, which provides information on the properties of 300 dangerous chemicals that are shipped in bulk.

- International Maritime Organization, *International Maritime Dangerous Goods Code.* Four loose leaf binders plus a supplement. Chemical shippers must follow this Code when labeling and stowing dangerous goods. Smaller shipments, which may be moved to the port by air or ground freight, are packaged according to the International Civil Aviation Organization's *Dangerous Goods Regulations*. The two codes are coordinated and form the basis of the DOT regulations in 49 CFR.

7210 Coast Guard Personnel On Scene

1. Upon arrival at the site of an incident, USCG representatives shall contact the Incident Commander and state their capabilities. At no time shall they endanger themselves during the response. The Coast Guard's role is mainly one of support, including:

A. Contacting other Federal agencies.

B. Notification of lead state agencies.

C. Providing chemical information, modeling, and planning support through ALOHA/CAMEO software, available through the USCG Operations Center.

D. Contacting the FOSC to arrange waterborne safety zones, personnel recovery by vessel, etc.

E. Issuing immediate SECURITE and waterway closure broadcasts to mariners.

F. Document case (Violation Report, POLREP, etc.).

7220 Maryland Department of the Environment Personnel On Scene

The Maryland Department of the Environment (MDE) acts as the State On Scene Coordinator (SOSC) through its Emergency Response Division. MDE personnel can provide technical assistance and direct intervention in support of local responders as needed. MDE maintains resources and limited funding to directly remove hazardous materials that may pose a substantial or imminent threat to human health and the environment.

7230 Local Response Organization Personnel On Scene

Local jurisdiction personnel are usually the first responders at the scene of any hazardous materials incident. The following local jurisdictions in the Baltimore AOR maintain fully trained and equipped hazardous materials response teams: Washington, DC; Anne Arundel County; Baltimore City; Baltimore County; Harford County; Howard County; Montgomery County; Prince George's County.

7300 Preliminary Assessment for Removal Actions by Federal On Scene Coordinator

1. Once the initial information has been collected, an evaluation must take place to ensure that the release is within the FOSC's response jurisdiction. The elements of jurisdiction are:

A. Release of a hazardous substance within the meaning of the:

(1) Federal Water Pollution Control Act, as per the lists in 40 CFR 117;

(2) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as per the lists in 40 CFR 302; or

(3) CERCLA as any contaminant posing “imminent and substantial danger to public health or welfare”, whether listed or not; or

(4) Resource Conservation and Recovery Act as per any of the lists or definitions of hazardous waste in 40 CFR 261.

B. A release not excluded reason of being:

(1) Solely contained within a workplace building; or

(2) A normal emission from an auto, truck, marine, or aviation engine or a pumping station; or

(3) By-products of nuclear power production; or

(4) A normal application of a pesticide or fertilizer; or

(5) On a DOD vessel or facility, unless DOD requests assistance.

2. The FOSC should determine if immediate removal is necessary. If it is not, refer the matter to EPA for remedial action.

3. Assign the incident a response level (minor, medium, or major)

4. Determine if state, local, and private agencies can handle the incident.

5. Contact appropriate support agencies and USCG Fifth District as necessary.

7400 Removal Steps to be Taken by the Federal On-Scene Coordinator

1. Issue a Letter of Federal Interest to any suspected responsible parties

2. Determine level of Coast Guard response necessary

3. Establish an Incident Command Post with communications systems, if one has not already been established.

4. Issue a Letter of Federal Assumption to any suspected responsible party, as necessary.

5. Activate USCG and EPA assistance team as necessary.

6. If CERCLA funding is needed, obtain a Federal project number from the National Pollution Fund Center.

7. Determine whether or not the container of hazardous materials should be moved to a safe haven to facilitate response.

8. Determine whether or not recovery of released material can be done or is desirable. Volatile chemicals may evaporate before they can be contained. Shock sensitive cargoes or massive leaks of corrosive material may pose too great a risk to responders at sea.

9. Ensure that monitoring is in place to provide adequate data to protect public health. Arrange for a disposal site for recovered materials.

10. Obtain an EPA hazardous waste generator ID number from the authorized state agency:

Maryland Department of the Environment
Waste Management
Hazardous Waste Program
2500 Broening Highway
Baltimore, MD 21224

Emergency Response (Day Hours)- (410)-333-2950
(Night Hours)- (410)-974-3551

Contact- Harold Dye- Program Administrator
(410)-631-3343

District of Columbia Emergency Management Agency
2000 14th St.
NW District of Columbia, 20009

Emergency Response (24 Hours)- (202)-727-6161
1-800-548-0191

11. Prepare a hazardous waste manifest, or have one prepared by a remediation contractor, for shipment of recovered materials and follow all EPA generator requirements.

7500 HAZMAT Class Behavioral Analysis

7510 Class I: Explosives and Blasting Agents

1. Divided into 6 Divisions by the Department of Transportation. Probability of accidental explosion decreases as one moves from Division 1.1 to Division 1.6.

2. Practically all are solids and are shipped in a packaged form rather than as bulk chemicals, and would remain in that form if spilled.

3. For safety, a “hot” zone should be declared around spilled explosives based on their blast damage potential.

7520 Class 2: Gases

Gases disperse in the atmosphere upon release, with only limited amounts dissolving in seawater. Analysis of hazards posed by Class 2 chemicals will be focused on the use of the ALOHA dispersion model. This is available as part of the SPEARS software at USCG Activities Baltimore. It is also loaded on computers operated by local and state HAZMAT teams.

7520.1 Division 2.1: Flammable Gases

1. *The North American Emergency Response Guidebook* recommends initial evacuation for at least ½ mile downwind for spills of most of these substances. The evacuation zone should be increased to 1 mile in all directions if the container becomes involved in a fire. The steps below will provide more information for specific cases.

2. Using ALOHA, compute the size of the zone within which the concentrations are expected to be above the Lower Explosive Limit (LEL, also called Lower Flammability Limit). Personnel within this zone are at a high risk of death if the cloud should ignite. The fire does not normally injure personnel outside this limit.

3. LEL values are not generally given in ALOHA. Enter it as an option in the Footprint calculation. The LELs for 26 of the 33 substances currently classified in Division 2.1 are given in Figure 7-3 below. The remaining Class 7 gases in this Division are chemically unusual and are not likely to be shipped by sea in any quantity. If no data is available, assume a conservative value of 1.0% by volume, which corresponds to 10,000 ppm.

4. The flammable cloud within the LEL may explode. The risk of explosion is greatly increased if the gas is confined within a container or a ship's hold. Development of these explosions is complex and depends in part on whether conditions exist for the formation of supersonic detonation waves. *The explosion develops over the width of the vapor cloud, rather than at a single point as occurs with solid explosives.* The peak pressure at the center of the blast is less than in the solid explosive case, but the zone of severe damage is often broader.

5. Responders on the scene of an accident involving Division 2.1 gases should carry combustible gas indicators.

Figure 7-3 Lower Explosive Limits for Flammable Gases, volume percentage

Name	UN #	LEL		Name	UN #	LEL
Acetylene	1001	2.5		Isobutane	1969	1.8
Butane	1011	1.9		Isobutylene	1055	1.8
Butadiene	1010	2.0		Methane	1971 1972	5.3
Butylene	1012	1.6		Methylacetylene (Propyne)	1060	1.7
Chlorodifluoro-ethane	2517	6.2		Methylamine	1061	4.9
Cyclobutane	2601	1.8		Methyl chloride	1063	8.1
Dimethylpropane	2044	1.4		Propane	1978	2.3
Ethane	1035	3.0		Propylene	1077	2.4
Ethylacetylene (Butyne)	2452	1.4		Tetrafluoroethylene	1081	10
Ethylamine	1036	3.5		Trifluoroethylene	1082	16
Ethyl chloride	1037	3.6		Trimethylamine	1083	1.2
Ethylene	1962	2.7		Vinyl fluoride	1860	2.6
Ethylene oxide	1041	3.0		Vinyl methyl ether	1087	2.6
Ethyl methyl ether	1039	2.0				

Use an LEL of 1.9% (19,000 ppm) for liquid petroleum gas

7520.2 Division 2.2: Non-flammable Gases

1. These gases pose a physical asphyxiation hazard. There is a high risk of shrapnel if a container of compressed gas becomes involved in a fire.

2. Responders on the scene should carry oxygen monitors. Atmospheres with less than 19.5% oxygen are considered oxygen deficient and should only be entered with SCBA equipment.

3. Oxygen is included in Division 2.2. Though it is not flammable itself, it supports combustion. Atmospheres with more than 23% oxygen are considered oxygen enriched. Devastating flash fires may occur in such circumstances. Large fires involving pure oxygen should be not be fought unless remotely operated equipment is available.

7520.3 Division 2.3 Toxic Gases

1. These gases generally have low OSHA Permissible Exposure Limits (PEL) and Immediately Dangerous to Life and Health (IDLH) concentrations. Failure of a single tank container could pose a hazard to a very wide area. ALOHA is designed for this type of event and should be run in all such cases. If the required IDLH values are not included in ALOHA, consult OSHA's *Pocket Guide to Chemical Hazards.*

2. Chemical-specific detector tubes are generally necessary to determine the concentration of these gases in air. *Draeger* and *Sensidyne* tubes are the best-known detectors for determining concentration.

3. If it is important to know the total dosage to response personnel or to members of the public, individual monitoring pumps can be used. These are about the size of a cell phone and adsorb the chemical onto a cartridge that is shipped for lab analysis.

7520.4 Division 2.4: Corrosive Gases

1. This Division is not a standard part of the United Nations scheme. It is used in Canada for 17 gases, of which ammonia and sulfur dioxide are the best known. The other 15 are corrosive fluorine or chlorine compounds. All 17 are classified as Division 2.3 under the United Nations system.

7530 Class 3: Flammable/Combustible Liquids

1. This class is not broken into Divisions. It is important to determine the flash point, specific gravity, and solubility of these materials. Use Figure 7-4 for initial analysis.

Figure 7-4 Behavior Modes for Combustible/Flammable Liquids

Hazards aboard vessel		Fate if material enters water		
Flash Point < 100 ^{o}F	**Flammable** Major fire hazard, including vapor cloud fires. See ***Note 1***	Specific Gravity < 1.0	Soluble	Rapid dissolution; fire hazard diminishes. See ***Note 3***.
				Behaves like

			Insoluble	gasoline. Fire hazard persists until material evaporates (several hours).
		Specific Gravity > 1.0	Sinks. Vapor and fire hazards minimal beyond ship. The USCG CHESPILL model can estimate dilution on the bottom. Possible hazard to public water intakes and bottom dwellers. See ***Note 2***.	
Flash Point 100 $^{\circ}$F - 200 $^{\circ}$F	**Combustible** Lower fire hazard, vapor cloud modeling not required.	Specific Gravity < 1.0	Soluble	Rapid dissolution; fire hazard diminishes. See ***Note 3***.
			Insoluble	Behaves like No. 2 fuel oil. See ***Note 4***.
		Specific Gravity > 1.0	Sinks. Vapor and fire hazards minimal beyond ship. The USCG CHESPILL model can estimate dilution on the bottom. Possible hazard to public water intakes and bottom dwellers. See ***Note 2***.	

Note 1. ALOHA should be run to predict the size of the vapor cloud within the Lower Explosive Limit (LEL). If an LEL value is not available, assume a value of 1% (10,000 ppm).

Note 2. CHESPILL is a model of “sinking chemical” spills originally developed for the USCG Research and Development Center by Louisiana State University in 1986. For most cases, CHESPILL shows that only part per million levels of the chemical will be found in the water column immediately after the spill. The remainder will sink quickly to the bottom where it will either be gradually broken up by turbulent shear stress, or absorbed by bottom sediments. Removal of the spilled material becomes a remediation action, not an emergency response. EPA or the appropriate state Department of Natural Resources will guide the remediation effort.

Note 3. Spills of liquids less dense than water initially spread very quickly under the influence of gravity. A spill from a standard tank container, which generally holds around 30,000-36,000 lbs, will spread to form a pool about 200 feet in diameter. Wave action will then break the pool into a cloud of droplets, which will be driven into the water column to a depth equal to about 3 times the wave height. The largest droplets, above 70 microns diameter, will rise back to the surface. The average droplet size decreases with the interfacial tension between seawater and the chemical. Since soluble materials have very small interfacial tensions with water, they will form a cloud of very fine droplets and the spill will be rapidly diluted into the top few feet of the sea. For 1-foot seas, the spill will be diluted by a factor of at least 200 within the first few minutes. At this point, the partial pressure of the chemical will diminish to near zero and the fire hazard will disappear.

Note 4. Tools used for predicting the relative motion of an oil spill can be used in this case. However, the cleanup strategy may be very different. The chemical may destroy conventional oil skimming equipment and pose special hazards to the removal workers. Commercial oil spill cleanup contractors may not be willing or able to handle these spills.

7540 Class 4: Hazardous Solids

7540.1 Division 4.1: Flammable Solids

1. These materials require an ignition source for combustion.

2. Division 4.1 is a small one and most of the members are wetted forms of commercial explosives. When shipped dry, these are Class I items. A few unusual metal compounds, and the moth repellent known as camphor also fall in Division 4.1.

7540.2 Division 4.2: Spontaneously Combustible

1. A surprisingly wide variety of materials are in this Division. It includes a number of self-heating solids that are shipped in great quantity, such as fishmeal, iron sponge, spent industrial catalysts, and activated carbon. These may or may not burn, depending on dampness, weather conditions, and storage configuration. It also includes some high-value organo-metallic compounds that can burst into flame spontaneously.

7540.3 Division 4.3: Dangerous When Wet

1. These are almost all reactive metals (sodium, lithium) and some of their more exotic compounds. Most generate hydrogen gas when placed in contact with water. The reaction may or may not be sufficiently violent to ignite the gas. If it does not, and the gas is confined, there is a risk of subsequent explosion. One, calcium carbide, generates acetylene, which is also explosive. One pound of calcium carbide produces 0.348 lbs acetylene. Finally, the five compounds shown below generate non-combustible toxic fumes. These toxic releases should be modeled using ALOHA.

2. In addition to the fire and explosion hazard, most of the reactive metal compounds generate corrosive reaction products with water. These are the hydroxides of the corresponding metal. See Figure 7-5.

Figure 7-5 Materials Which Generate Toxic Vapors with Water

One pound of...	generates	...of:
Calcium phosphide	0.37 lbs	Phosphine
Aluminum phosphide	0.58 lbs	Phosphine
Zinc phosphide	0.26 lbs	Phosphine
Trichlorosilane	0.81 lbs	Hydrogen chloride
Lithium amide	0.74 lbs	Ammonia

7550 Class 5: Oxidizers and Organic Peroxides

7550.1 Division 5.1: Oxidizers

1. Oxidizers contribute to a fire or explosion when combustible material is present in the immediate area.

2. Compute the explosion hazard by assuming that the spilled material is mixed with a combustible fuel such as diesel oil or sawdust.

7550.2 Division 5.2: Organic Peroxides

1. Organic peroxides are generally shock-sensitive and will self-detonate without a need for additional fuel. Explosions are fairly frequent in factories and warehouses that handle them.

7560 Class 6 Poisons

1. Under the international regulations, this Class is divided into Division 6.1 (Toxic Chemicals) and Division 6.2 (Infectious Substances). In North America, the most toxic of the toxic chemicals carry the skull and crossbones “Poison” label. The less dangerous items carry the “Harmful - Stow Away From Foodstuffs” label. Class 6 is very large.

2. Responses to spills of toxic materials can become very complex, because of the threat to cleanup workers. The *NIOSH Pocket Guide to Chemical Hazards* should be consulted early in the incident. The National Strike Force Coordination Center should also be involved as soon as the incident begins to evolve beyond a minor, short-term event.

3. Most of these materials are liquids. For purposes of analysis, it is necessary to know the density, solubility, and vapor pressure of the chemical. Use Figure 7-6 as a guide.

Figure 7-6 Behavior Models for Toxic Liquids

Hazards aboard vessel		Fate if material enters water		
Vapor Pressure > 40 mmHg	Potentially major inhalation hazard. Response and cleanup workers may require OSHA Level A or B protective equipment. See ***Note 1.***	Specific Gravity < 1.0	Soluble	Rapid dissolution, inhalation hazard diminishes. See ***Note 3***.
			Insoluble	Behaves like gasoline. Inhalation hazard persists until material fully evaporates (several hours).

		Specific Gravity > 1.0	Sinks. Vapor and fire hazards minimal beyond ship. The USCG CHESPILL model can estimate dilution on the bottom. Possible hazard to public water intakes and bottom dwellers. See ***Note 2***.	
Vapor Pressure <40 mmHg	Lesser inhalation hazard, depending on toxicity (IDLH/10 or TLV level). Dermal and ingestion hazards. Response and cleanup workers probably will require OSHA Level C or D protective equipment.	Specific Gravity < 1.0	Soluble	Rapid dissolution. See ***Note 3***.
			Insoluble	Behaves like No. 2 fuel oil. Dermal contact hazards. See ***Note 4***.
		Specific Gravity > 1.0	Sinks. Vapor hazards minimal beyond ship. The USCG CHESPILL model can estimate dilution on the bottom. Possible hazard to public water intakes and bottom dwellers. See ***Note 2***.	

Note 1. ALOHA should be run to predict the size of the vapor cloud within the concentration of concern. This is typically the IDLH/10 or the NIOSH TLV concentration, and is given in ALOHA. If it is not included in the database consult the *NIOSH Pocket Guide to Chemical Hazards*.

Note 2. CHESPILL is a model of sinking chemical spills originally developed for the USCG Research and Development Center by Louisiana State University in 1986. For most cases, CHESPILL shows that only part per million levels of the chemical will be found in the water column immediately after the spill. The remainder will sink quickly to the bottom where it will either be gradually broken up by turbulent shear stress, or absorbed by bottom sediments. Removal of the spilled material generally becomes a remediation action, not an emergency response. EPA or the appropriate state Department of Natural Resources will guide the remediation effort. In the case of highly toxic materials, it may be necessary to extend the emergency response phase until public drinking water intakes are no longer threatened.

Note 3. Spills of liquids less dense than water initially spread very quickly under the influence of gravity. A spill from a standard tank container, which generally holds around 30,000-36,000 lbs, will spread to form a pool about 200 feet in diameter. Wave action will then break the pool into a cloud of droplets, which will be driven into the water column to a depth equal to about 3 times the wave height. The largest droplets, above 70 microns diameter, will rise back to the surface. The average droplet size decreases with the interfacial tension between seawater and the chemical. Since soluble materials have very small interfacial tensions with water, they will form a cloud of very fine droplets and the spill will be rapidly diluted into the top few feet of the sea. For 1 foot seas, the spill will be diluted by a factor of at least 200 within the first few minutes. At this point, the partial pressure of the chemical will diminish to near zero and the fire hazard will disappear.

Note 4. Tools used for predicting the motion of a oil spill can be used in this case. However, the cleanup strategy will be very different. The chemical may destroy conventional oil skimming equipment and will pose special hazards to the removal workers. High levels of personal protective equipment (OSHA levels A or B) may be required - these are awkward and possibly dangerous to wear on a small boat. Commercial oil spill cleanup contractors will probably not be willing or legally able to handle these spills.

7570 Class 7: Radioactive Materials

1. Shipments of radioactive materials by sea are uncommon in the Baltimore AOR. Many are high value, low volume items that would normally be shipped by air or ground.

2. Radiation monitoring equipment and guidance from a health physicist should be available for any response.

3. Packages for radioactive material are built to withstand mechanical damage and fire. Highly radioactive materials are transported in stout packaging known as "Type B" which can withstand a variety of external challenges.

4. Some radiation is normal even from intact packages. The expected amount of radiation at 1 meter from the package (known as the "Transport Index") is indicated in a rectangular box on the yellow/white HAZMAT label. The Transport Index may be expressed as milliroentgens per hour or Sieverts per hour. If the monitored level is higher than the Transport Index, the package may have leaked.

5. Safety of life takes priority over radiological concerns. Do not unnecessarily delay rescue or transport of a seriously injured person from the scene.

6. High level nuclear waste, nuclear fuel, and nuclear weapons are moved only with trained and armed escorts and pre-approved incident response plans are developed for each shipment.

7. Oak Ridge Associated Universities has published a pamphlet titled *Transport of Radioactive Materials - Questions and Answers about Incident Response.* This is fairly widely distributed in the emergency services community and contains valuable information for first responders.

8. The U.S. Department of Energy's Radiological Assistance Program (RAP) should be contacted in the event of any serious incident involving radioactive materials. RAP personnel will be able to mobilize additional specialized Federal resources as needed to respond to an event. RAP personnel can be contacted at any time through the Department of Energy Emergency Operations Center, (202) 586-8100.

7580 Class 8: Corrosives

1. This a broad class of compounds, many of which are commercially important. Corrosives, especially sulfuric acid, are shipped in large volumes through the Baltimore AOR.

2. The members of Class 8 are mostly liquids or soluble solids. The analysis is thus a little like that for Class 3 and Class 6 materials, with the difference that they are all water-soluble.

3. First responders should understand that many corrosives are not just “acid” or “caustic”, and may pose a substantial inhalation hazard. See Figure 7-7 below for more information.

Figure 7-7 Behavior Models for Corrosive Materials

Hazards aboard vessel		Fate if material enters water	
Vapor pressure > 40 mmHg	Potentially major inhalation/skin absorption hazard. Response workers will probably need	Specific Gravity < 1.0	Rapid dissolution; contact and inhalation/ absorption hazards diminish. See ***Note 3***.

	OSHA Level A protective equipment. Cleanup workers may be able to dilute or absorb the spilled materials and then work in Level C or D. See ***Note 1***.		
		Specific Gravity > 1.0	Sinks. Vapor and contact hazards minimal beyond ship. Models can estimate dilution on the bottom. Possible hazard to public water intakes and bottom dwellers. See ***Note 2***.
Vapor pressure < 40 mmHg	Lesser inhalation and absorption hazard. Response and cleanup workers will probably wear OSHA Level C or D PPE	Specific Gravity < 1.0	Rapid dissolution; Contact hazard diminishes. See ***Note 3***.
		Specific Gravity > 1.0	Sinks. Vapor and contact hazards minimal beyond ship. Models can estimate dilution on the bottom. Possible hazard to public water intakes and bottom dwellers. See ***Note 2***.

Note 1. ALOHA should be run to predict the size of the vapor cloud within the concentration of concern. This is typically the IDLH/10 or the NIOSH TLV concentration, and is given in ALOHA. If it is not included in the database consult the *NIOSH Pocket Guide to Chemical Hazards*. For corrosives, the chemical of concern is frequently present at less than 100%. The partial pressure of the toxic component above the solution is much less than that of 100% pure liquid.

Note 2. CHESPILL is a model of sinking chemical spills originally developed for the USCG Research and Development Center by Louisiana State University in 1986. For most cases, CHESPILL shows that only part per million levels of the chemical will be found in the water column immediately after the spill. The remainder will sink quickly to the bottom where it will either be gradually broken up by turbulent shear stress, or absorbed by bottom sediments. Removal of the spilled material generally becomes a remediation action, not an emergency response. EPA or the appropriate state Department of Natural Resources will guide the remediation effort. In the case of highly toxic materials, it may be necessary to extend the emergency response phase until public drinking water intakes are no longer threatened.

Note 3. Spills of liquids less dense than water initially spread very quickly under the influence of gravity. A spill from a standard tank container, which generally holds around 30,000-36,000 lbs, will spread to form a pool about 200 feet in diameter. Wave action will then break the pool into a cloud of droplets, which will be driven into the water column to a depth equal to about 3 times the wave height. The largest droplets, above 70 microns diameter, will rise back to the surface. The average droplet size decreases with the interfacial tension between seawater and the chemical. Since soluble materials have very small interfacial tensions with water, they will form a cloud of very fine droplets and the spill will be rapidly diluted into the top few feet of the sea. For 1-foot seas, the spill will be diluted by a factor of at least 200 within the first few minutes. At this point, the partial pressure of the chemical will diminish to near zero and the fire hazard will disappear.

Note 4. Tools used for predicting the motion of a oil spill can be used in this case. However, the cleanup strategy will be very different. The chemical may destroy conventional oil skimming equipment and will pose special hazards to the removal workers. High levels of personal protective equipment (OSHA levels A or B) may be required - these are awkward and possibly dangerous to wear on a small boat. Commercial oil spill cleanup contractors will probably not be willing or legally able to handle these spills.

7590 Class 9: Miscellaneous

1. Class 9 contains a variety of substances that pose unusual hazards or are of environmental concern without actually posing an acute hazard.

2. Aerosol cans, self-inflating life jackets, and other items of apparatus, which might behave dangerously in a fire are included in Class 9.

3. PCBs, asbestos, polystyrene beads, and wastes legally defined as hazardous are in this class.

4. Dry ice is a Class 9 item.

7600 **Reserved**

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